13. Maintenance and expected lifespan

After successful installation, the required regular maintenance of a fixed camera is normally to clean the outside lens. Depending on the strength of the camera's mounting and the stability of the structure it is attached to, occasional repositioning of the camera to correct the viewing angle may be required, especially for exterior applications. (It is not unusual to see one or more incorrectly positioned camera scenes on the monitors of an established security communications room because regular maintenance of camera mountings has not been provided for.)

Housings will protect the camera lens from dust and dirt, but the glass front of the housing must be kept clean. Some super housings come with their own wiper blades and wiper fluid dispenser. The dispenser mechanism is activated remotely by an operator to keep the camera scene clear. However, this feature can add to the required regular maintenance as the dispenser must be refilled with fluid as needed.

The dome enclosures for interior ceiling-mounted cameras (usually pan-tilt-zoom cameras) are intended to reveal the presence of a camera but not its current direction or field-of-view. Dust (or mischief) can obscure the view, but otherwise, maintenance is low.

The average lifespan of a modern solid-state camera is greater than 5 years. Many camera failures occur early in a camera's life. This allows for most cameras with defects to be returned during the warranty period.

Cameras do occasionally need repair, so the availability of parts should be considered. This can make a good deal on an older camera system less fortuitous. If a camera unit used in a critical application must be sent away for repair, it is wise to have a backup camera available. Maintenance contracts should always address repair time and the availability of loaner units.

In the absence of a maintenance contract, there are many local repair shops in most medium and large cities. Check the availability of local repair options before you purchase your system. There are several resources for camera maintenance available to customers across the country who are willing to ship their equipment; repair generally takes less than 2 weeks. Most of these resources may be located on the Web.

14. Price ranges

Standard-resolution solid-state cameras can cost between $300 and $1,000. High-resolution cameras can range anywhere from $1,500 to $8,000. For most school applications, the standard-resolution camera is probably adequate. The less expensive cameras (nearer to $300) need more light to accurately capture a scene. The more expensive cameras ($1,000 or more) tend to be more sensitive, using more sophisticated electronics so that they require less light to accurately capture a scene.

15. Going out on bid for equipment and system maintenance contracts

While it is difficult to prevent every possible mistake when going out on bid for CCTV systems, there are a few commonsense approaches that should be incorporated

in every request for quote (RFQ). The security equipment industry is no different from any other supplier; they will bid on and provide what is asked for. Even generally standard options that would seem reasonable to assume would be included should not be assumed to be part of any RFQ. If you can precisely describe what you require, the bidders will be less apt to submit bids on dissimilar systems.

Do not accept or pay for a camera system until it has been installed and is demonstrated to operate according to your specifications. Remember, the vendor doesn't like surprises any more than you do so specify your acceptance criteria very clearly in the RFQ. This includes the "quality" of installation (exhibit 2.14); occasionally a contractor may try to save money by merely tacking cabling along the top of a wall instead of running the cabling within a conduit and within the ceiling. Don't assume anything.

When going out on bid, the ideal specifications for a CCTV system would describe the desired capabilities or goals of the system, not the quantities of different components. For example, if it is desired to have cameras viewing the locker bay area to discourage and identify daytime thieves, do not request "two cameras, one installed at the end of each hallway." A more profitable request could be: "The images saved to videotape and viewed on the system monitor will allow the customer to distinguish, as a measure of acceptance testing, between the geometry teacher and the school secretary standing anywhere within the locker bay area, with at least one image per camera captured and recorded per second. Quoted product and installation should be vandal-proof, such that an individual, given a few minutes of uninterrupted time, would not be able to vandalize the equipment without being recorded on tape and being identifiable, providing they are not wearing any type of mask." Include room dimensions and even a few photographs of the area for which the requested equipment is intended, or offer all potential bidders a tour of the area.

It is common for the prices received from such a request to be substantially higher than the school originally intended. It is efficient to include a request in the original RFQ for two different camera layouts and their associated costs. One layout would provide the exact capability requested. The second layout would be the best possible configuration within a specified dollar amount, with the expected capabilities as well as deficiencies that are expected with this layout, clearly identified by the vendor. It is to both the school's and vendor's benefit to request these two different layouts—a principal or security official armed with such information can approach the school district or school board to request the additional funding necessary to meet the goals of the security system if the less expensive system will perform substantially below the school's requirements.

Typical warranties on video cameras are 90 days, with up to a year or more for more sophisticated cameras. It is common for cameras that are defective to fail fairly quickly after installation. Be prepared for this; assign a person to be responsible for checking regularly on the functioning of the equipment and to immediately remove failing components and return them to the manufacturer within the warranty period, or to contact the vendor and make certain that he responds in a reasonable amount of time.

Exhibit 2.14. This is an example of a sloppy installation job—be careful how you word a contract for installation.

If a school does desire to have a maintenance contract, either because of lack of internal manpower or because of available funding, the vendor should specify the maximum time it will take to respond to calls for help and the maximum time the customer will have to be without this equipment if a repair is required. It is possible for a school to request faster response times or even that the maintenance contractor provide loaner equipment for any down time greater than 24 or 48 hours; however, this will increase contract costs.

16. Signage for use of cameras on school grounds

Very visible and hard-to-miss signs at the entrances to a school campus and at major entrances into school buildings serve many purposes. Their value to security should not be underestimated. Signs are not overly expensive, but the price of not having one can sometimes be astronomical.

- Signs that inform the public and the school occupants that certain security measures are in force can provide a frontline deterrent. Without any other knowledge, an outsider faced with the choice of vandalizing a school with security warning signs or a school with no signs or other obvious indications of self-defense will choose the latter.

- As described in the section of this manual on legal issues, liability can be minimized through the use of signs. A piece of information that can be important to include on a warning sign is whether cameras are not being monitored. There have been a few lawsuits in the United States that have been filed and consequently won because someone at a facility was attacked, but the victim did not try to defend himself or herself against the perpetrator; he or she was under the impression that, because a video camera was aimed directly at him or her, help would surely arrive soon. This is a common assumption. Sample wording for a school sign regarding this particular issue could be:

  WARNING: This facility employs video surveillance equipment for security purposes. This equipment may or may not be monitored at any time.

- Covert approaches to security can sometimes be open to contention, especially by someone who is caught in this way. The use of covert cameras can be extremely effective in providing evidence for prosecution; however, not all school districts or school boards will support their use. It may not be necessary, however, to post signs regarding every security detail being incorporated on a campus. It may be quite sufficient to insert a warning regarding the use of covert cameras in the school policy document that is signed by every student and parent at the beginning of the school year and in the contracts signed by every employee. (Don't forget to include this information in contracts for outside services.)

17. Legal aspects of the use of video cameras in schools

Laws concerning privacy issues and civil rights may vary widely, so before beginning any electronic surveillance program, be sure to check with your school attorney. However, the following generalities are fairly consistent across most of the country:

Cameras may *not* be used in an area where there is a "reasonable expectation of privacy." Examples of these are bathrooms, gym locker/changing areas, and private offices (unless consent by the office owner is given). Examples of where cameras are generally acceptable are in hallways; parking lots; front offices where students, employees, and parents come and go; gymnasiums; cafeterias; supply rooms; and classrooms. The use of cameras in classrooms is often debated by teachers who want cameras for protection and teachers who do not. At this point in time, it is probably wise to use cameras in classrooms only when the teacher is given an option and notification that a camera is to be used.

Signage can be an important legal component in the use of video cameras in schools. As mentioned in the previous section, it is important that the presence of video cameras not lead a person to believe he or she will be rescued if attacked. Dummy cameras should not be used (which is in contrast to the "black boxes" on buses, in which cameras may or may not be located at any time). While a fake camera can create a temporary deterrent to some security incidents, the potential liability it creates due to a victim's impression of being rescued quickly is not acceptable.

Audio recording is often considered to be of greater legal concern than video recording in most States. The recording of conversations is viewed as more of an invasion of privacy, as conversations often take place where the participants do not expect to be overheard.

B. Video recording equipment

1. VCRs: the weak link

The video cassette recorder (VCR), commonly used in most school surveillance systems, is the weakest link in the video system due to its mechanical nature. (The more reliable but much more expensive digital recorder is discussed later.) Industrial quality VCRs range in price from $500 to $4000. A school can plan to spend approximately $500 to $1,200 for a good-quality VCR appropriate for most of its applications. (This price range does not necessarily include some of the desirable features discussed later.) The inexpensive $200 VCR is not recommended for nonhome use.

Unfortunately, the most ignored maintenance task in most school security departments is the regular servicing and cleaning of VCRs. VCR heads should be cleaned after every 100 hours of use—about every 4 days of constant recording. This head cleaning can be accomplished using isopropyl alcohol and industrial swabs and takes about 10 minutes. The cleaning tapes that are available to clean VCR heads are not recommended, as they can cause excessive wear on the heads. The entire VCR unit should be serviced every 2,400 hours, or about every 3 months of constant use. This complete servicing includes replacement of bands and rubber components. If well-serviced, a typical VCR will last about 4–5 years with constant use. At least one moderately expensive

($200–$300) head replacement should be expected during this time.

Premium-quality tapes are recommended for the constant use experienced in most school applications. These tapes will cost about $10 each and are available from your VCR vendor. Their expected quality lifespan is about 25 recordings. Recording over the same tape indefinitely is not recommended because this practice introduces several logistical problems. Sometimes incidents are reported several days after they occur, and the video of the incident has already been recorded over. A good recording plan includes 6 new tapes every fall and spring, labeled Monday, Tuesday, . . . Friday, and Weekend. Each morning, the appropriate tape is put into the VCR. When an incident occurs, that particular tape should be pulled and labeled as "removed," along with the date it was most recently recorded on. A new tape labeled with that day of the week should replace the original. If faithfully done, this will probably be adequate for most schools. By replacing the tapes every spring and fall, the tape quality is not compromised.

VCRs, which operate at temperatures between 32°F and 104°F, need to be used indoors where relative humidity is less than 80 percent and the air is free of noncondensing moisture. Because an industrial time-lapse recorder is designed to run 24 hours a day for long periods of time, proper physical location of the unit must be considered. Recorders generate heat, and because heat is the worst enemy of the recorder (next to dirt), the recorder must be placed in a well-ventilated location. If the recorder is to be installed in an environment where there is a lot of dust or dirt in the air, provisions must be made to keep the unit clean. (A single grain of dirt in the right place can crack a video head.) If a recorder must be placed in a dirty environment, a housing with a fan, vent holes, and filters should be used.

Another important consideration in setting up a VCR is locating it in a secure, protected area (exhibit 2.15). VCRs are attractive targets for thieves, but even more importantly, tapes can be stolen or destroyed if there is an illegal incident to be covered up. VCRs should usually be placed in a strong locking cabinet within a locked room. Only the school principal and one security person should have the key to this cabinet.

2. Multiplexers

Multiplexers can be used to combine two or more individual video camera signals and send them to a single recorder. This is often referred to as timeshare multiplexing and allows up to 16 video camera signals to be recorded on a single half-inch videocassette simultaneously and played back as individual pictures or combinations of pictures upon command. A multiplexer could be either a simplex multiplexer or duplex multiplexer. The simplex multiplexer can only display a full-screen image of one selected camera or a sequence of selected cameras while recording. A duplex multiplexer can also display multiscreen images while still recording. Essentially, a multiscreen display consists of a split screen that allows for the viewing of all camera images on the system simultaneously (exhibit 2.16).

Timeshare multiplexing can also be used to transmit multiple video camera signals (up to 16) from one point to a second point by a single cable or transmitter

Exhibit 2.15. This video recording equipment is protected by a simple locked and vented cabinet that resides within a locked room.

Exhibit 2.16. These monitors in the principal's office display the camera signals from the main entrance to Belen High School in New Mexico, and allow Ron Marquez to keep tabs on student entry and exit, even while he is in meetings.

(microwave, fiber optic, infrared). Another multiplexer at the second point can be used to separate the multiple video signals back into individual video signal outputs.

A duplex multiplexer is higher in cost than a simplex multiplexer. Generally, a duplex multiplexer is used if someone is watching or operating the system while it is recording; if it is unmanned, as in many school applications, a simplex multiplexer is more cost-effective. A true duplex system allows the user to watch multiple screens while recording without affecting the multiplexed output to the video camera recorder (VCR).
A simplex system allows for full-screen or sequenced viewing in the record mode. If multiscreens are activated during the recording, the multiscreen itself might be recorded, thereby not allowing full-screen playback. A duplex system also allows for recording and playback simultaneously if two VCRs are connected. The multiplexer should provide two monitor inputs if this feature is used so live viewing of the facility is not lost. In most applications, a simplex unit is suitable and more economical if recording can be stopped while the video is reviewed. The recorded videotape can then be retrieved in a full-screen or in a multiscreen configuration.

Most multiplexers available from established manufacturers feature camera titling for recording and a permanent time/date stamp on each frame of recorded video.

Another feature is compensation for camera synchronization. Multiplexers are equipped with an alarm input for each camera. When activated, these can be used to generate an output to the VCR to place both the multiplexer and VCR into the 2-hour recording mode (real time) for a predetermined period of time.

Some multiplexers allow only images from the alarm camera to be recorded, but others allow a choice of interleaving (every other field). Onscreen programming of the multiplexer allows for simpler programming and review of settings. Programming features should display VCR tables because it is important to synchronize the multiplexer to the particular model and brand of VCR to avoid missing crucial information.

3. Time-lapse recorders

Time-lapse recorders have the ability to incrementally record at specific time intervals, recording a single field or frame of video information with each increment. In the 2-hour (real time) recording mode, a video recorder is recording 60 fields or 30 frames of video information each second. To determine the time interval between pictures recorded at specific speeds, the following formula can be used (based on using a T120 tape at 60 Hz):

$$\frac{\text{Recording speed}}{120} = \text{Seconds between frames}$$

Because the tape is slowed down in the time lapse mode, and the video heads record only specific fields of information, some actions are easily lost. If a tape recorded in real time (2-hour) was compared to a tape recorded at a 240-hour speed, there would be lost information between them. The slower the tape speeds during recording, the more information that can be lost. Exhibit 2.17 presents recording intervals for various recording tape speeds.

There are some low-priced time-lapse recorders (approximately $500) on the market today, but dependability and resolution may be sacrificed if an industrial-quality recorder with at least 400 lines of

resolution (approximately $1,200–$2,700) is not specified. A high-resolution camera and monitor may be used with good results during realtime viewing, but if the playback tape has been recorded with a standard time-lapse recorder with low resolution, the results may be disappointing. For best results, a high-resolution industrial-quality recorder should be used.

4. Event recorders

It may not be necessary to have all the features of a time-lapse recorder. Time lapse was developed to give a continuous flow of recorded information that could span long periods of time in a very small, storable format. If a school is able to interface its intrusion detection or other type of alarm system with their CCTV system (which is viewing the area where an alarm is occurring), an event recorder is capable of turning itself on to record that event almost instantaneously. Not only does this feature allow a tape to be used for very long periods of time, as no recording is being done during uneventful times, but event recorders are generally cheaper than time-lapse recorders.

5. Digital recorders

The security industry now has access to technology that allows the digital recording of full-motion video. Over the next few years this type of system will likely become even more accessible, with an increase in digital storage technology and a decrease in the overall costs associated with hardware. Digital storing and recording have many advantages over a time-lapse or event recorder. The most important advantage is that digital recorders require no human intervention, which means no maintenance and no cleaning. On the other hand, a major disadvantage is that the security industry has yet to establish standards for compressing digital information for recording (compressed digital information takes up less storage space). Hence, it is common to experience compatibility problems between alarm monitoring systems.

For school applications, a major consideration is the increased cost of digital recorders over conventional video recorders. A minimum system for digitally stored images on a hard drive is estimated to cost at least $3,000. Without video compression hard-

Exhibit 2.17.

Recording speed (hours)	2	12	24	72	120	168	240	360	480	600	720
Recording speed (days)	1/12	1/2	1	3	5	7	10	15	20	25	30
Recording intervals per field (seconds)	0.02	0.1	0.2	0.6	1	1.4	2	3	4	5	6

ware/software, the digital storage system is not very practical; it has been estimated that the cost for a single stored image is $0.94 for black-and-white and $2.81 for color. Using the compression methods available today increases the storage capacity with acceptable video quality by approximately 10 times. The additional cost of the compression system is at least $1,500, making the cost of the complete digital recording system about $4,500, which yields a cost-per-image of $0.047 for black-and-white and $0.141 for color video. For comparative purposes, the cost of storing images on a typical video cassette recorder is many times less—each T120 video cassette holds 432,000 black-and-white or color images at a cost of roughly $0.003 per image (including the cost of the VCR).

While the cost of digital storage systems has been decreasing and will continue to decrease as technology improves and the capacity of these devices increases, the cost of tape will probably be much lower than the cost of hard drives for some time to come. Consequently, the security industry will likely parallel the computer industry in storage techniques, using hard drives for short-term storage but keeping archival storage on low-cost tape systems.

Exhibit 2.18. A weapon detection system with x-ray detector for carried items and two portal metal detectors for walk-through.